Accessing, Utilizing and Visualizing NASA Remote Sensing Data For Malaria Modeling and Surveillance

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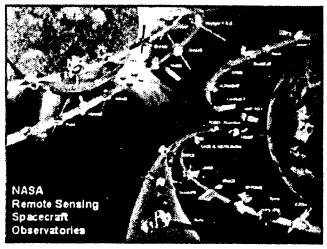


The transmission of vectorborne infectious diseases is often influenced by environmental, meteorological and climatic parameters. For example, the geophysical parameters relevant to malaria transmission include precipitation, surface temperature, humidity, elevation, and vegetation type. Because these parameters are routinely measured by satellites, remote sensing is an important technologic tool for predicting, preventing, and containing malaria transmission.

Currently, there are 69 NASA remote sensing missions.

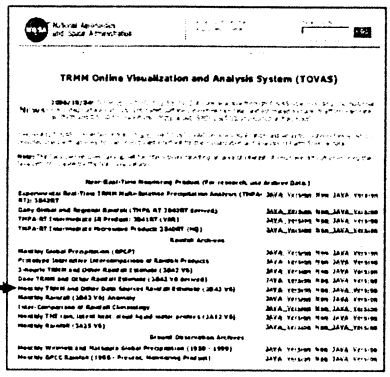
Some of the environmental determinants that are available as data products (X) or can be computed or inferred using satellite measurements are shown below. The sensors or spacecraft in red are US-Japan collaborated missions.

	Ground Cover Type	Vegetation Index	Surface Temperature	Rainfall	Humidity
Landsat ETM+	computed	computed		inferred	
AVHRR	computed	X	over sea surface	inferred	
MODIS	computed	X	X	inferred	computed
TRMM	computed	computed		X	
ASTER	computed	computed		inferred	
EO-1 ALI	computed	computed		inferred	
GMAO Climate Forecast			X	X	X

Because rainfall is the most important environmental determinant for malaria transmission, we will explain how to obtain precipitation data acquired by **Tropical Rainfall Measuring Mission** in details. The **TRMM Online Visualization and Analysis System** is a convenient web-based tool to visualize TRMM data, perform certain analyses, and download data.

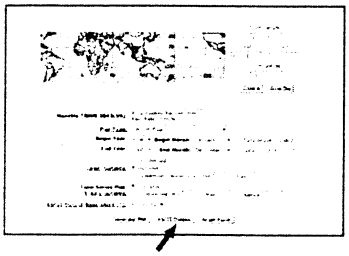
TRMM offers a variety of rainfall products

daac.gsfc.nasa.gov/techlab/giovanni ▶ TRMM



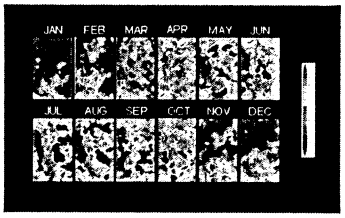
Directly accessing TRMM rainfall data by lifting ASCII data off screen

disc2.nascom.nasa.gov/Giovanni/tovas/TRMM_V6.3B43.shtml



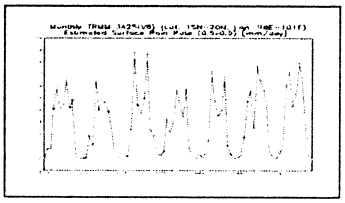
For example, monthly precipitation is one of the parameters that can be obtained easily with the web-based TOVAS. Monthly rainfall distribution (mm/day) over Thailand in 2006 are shown below.

TRMM Monthly Precipitation over Western Thailand in 2006 summarized by TOVAS



As another example, monthly rainfall (in mm/day) over the western Thai provinces bordering with Myanmar (15°N–20°N and 98°E–101°E) from 2000 to 2007 can also be obtained using TOVAS.

TRMM Monthly Precipitation Time Series over Thailand From 2000 to 2007 summarized by TOVAS

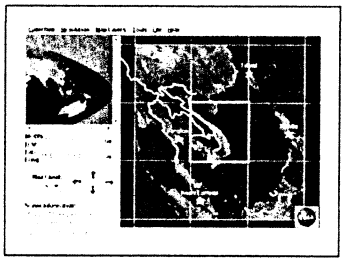


Viewing Landsat 7 ETM+ Imagery Data

eros.usgs.gov/products/satellite.html

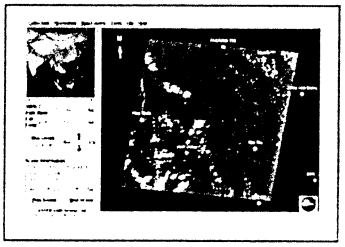
Viewing MODIS Imagery Data

eros.usgs.gov/products/satellite.html



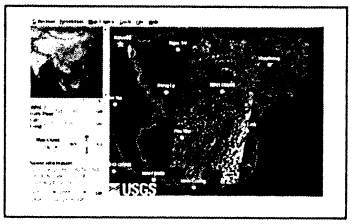
Viewing ASTER Imagery Data

eros.usgs.gov/products/satellite.html



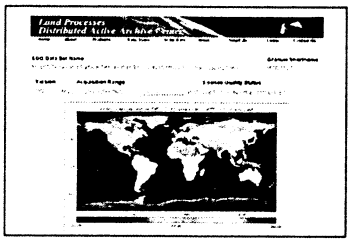
Viewing EO-1 Advanced Land Imager data

eros.usgs.gov/products/satellite.html



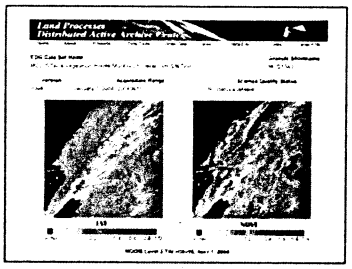
Downloading or ordering MODIS surface temperature data product

lpdaac.usgs.gov/modis/mod11c3v4.asp



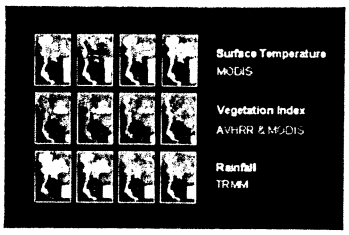
Downloading or ordering MODIS vegetation data (NDVI) product

lpdaac.usgs.gov/modis/mod13a3v4.asp

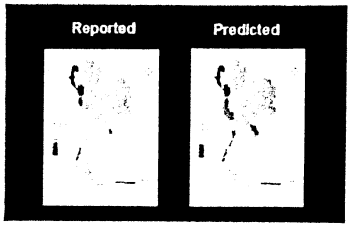


An example for modeling malaria incidence

For example, we use rainfall, temperature, humidity, and vegetation index along with malaria time series to model and predict malaria incidence. Some of the geophysical parameters extracted from satellite measurements for the four seasons in Thailand are shown below. The four seasons we use are Cool-Dry (Nov–Jan), Hot-Dry (Feb–Apr), Early Rainy (May–Jul), and Late Rainy (Aug–Oct).



Neural network methods are used for prediction. Predicted incidence rates are in good agreement with reported rates.



Accessing, Utilizing and Visualizing NASA Remote Sensing Data For Malaria Modeling

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The transmission of malaria is influenced by a myriad of factors. Environmental, climatic, socioeconomic, public health, political, and wartime conditions have all been shown to contribute to malaria occurrence and outbreaks. Among these, the environmental conditions, especially rainfall, appears to be the most recognizable determinant. The geophysical parameters relevant to malaria transmission include precipitation, surface temperature, humidity, elevation, and vegetation type. Because these parameters can be routinely measured over large areas using remote sensing, remote sensing is an important technologic tool for predicting, preventing, and containing malaria epidemics.

A variety of NASA remote sensing data can be used to extract environmental information for modeling malaria transmission. We will discuss both the well known and less known remote sensing data, including Landsat, AVHRR (Advanced Very High Resolution Radiometer), MODIS (Moderate Resolution Imaging Spectroradiometer), TRMM (Tropical Rainfall Measuring Mission), ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer), EO-1 (Earth Observing One) ALI (Advanced Land Imager), and SIESIP (Seasonal to Interannual Earth Science Information Partner) dataset.

The precipitation data is from TRMM data product 3B43, which can be acquired using the Giovanni tool at the NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) (http://disc2.nascom.nasa.gov/Giovanni/tovas). Giovanni is a Web-based application developed by the GES DISC that provides a simple and intuitive way to visualize, analyze, and access vast amounts of Earth science remote sensing data without having to download the data. The temperature and NDVI data are from MODIS products MOD11/MYD11 and MOD13/MYD13 respectively. These global monthly products are available for download from LPDAAC (Land Processes Distributed Active Archive Center) (http://lpdaac.usgs.gov). The MODIS water vapor product MOD05/MYD05, which can be used for deriving relative humidity, is distributed by the Level One and Atmosphere Archive and Distribution System (LADS) in MODIS Adaptive Processing System (MODAPS) (http://ladsweb.nascom.nasa.gov). Digital elevation data are from the Shuttle Radar Topography Mission (SRTM) (http://www2.jpl.nasa.gov/srtm). ASTER, ALI and Landsat data can be downloaded from the USGS Global Visualization Viewer (http://glovis.usgs.gov). This tool is capable of viewing basic images and certain products from sensors such as EO-1, ASTER, Landsat, and MODIS. Climate forecast data is available from NASA Goddard Modeling and Assimilation Office (GMAO) (http://gmao.gsfc.nasa.gov).

Examples for accessing, visualizing and analyzing the remote sensing data described above will be given. Examples for modeling the spatiotemporal malaria transmission risks in Thailand and other counties based on remotely sensed geophysical parameters will be discussed in another presentation.